

Muon multiple scattering study in the SF

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Purpose

- Cross-check momentum ID and SF alignment
- Check SF alignment

Goal

- Find the momentum dependence of the residuals for straight-through muons

Method

- Find the momentum of straight through muons.
- Once a track is found,
 - remove it
 - re-decode with the new SF decoder
 - find tracks using local fiber maxima
- histogram the momentum of the original track and the residuals of the new track

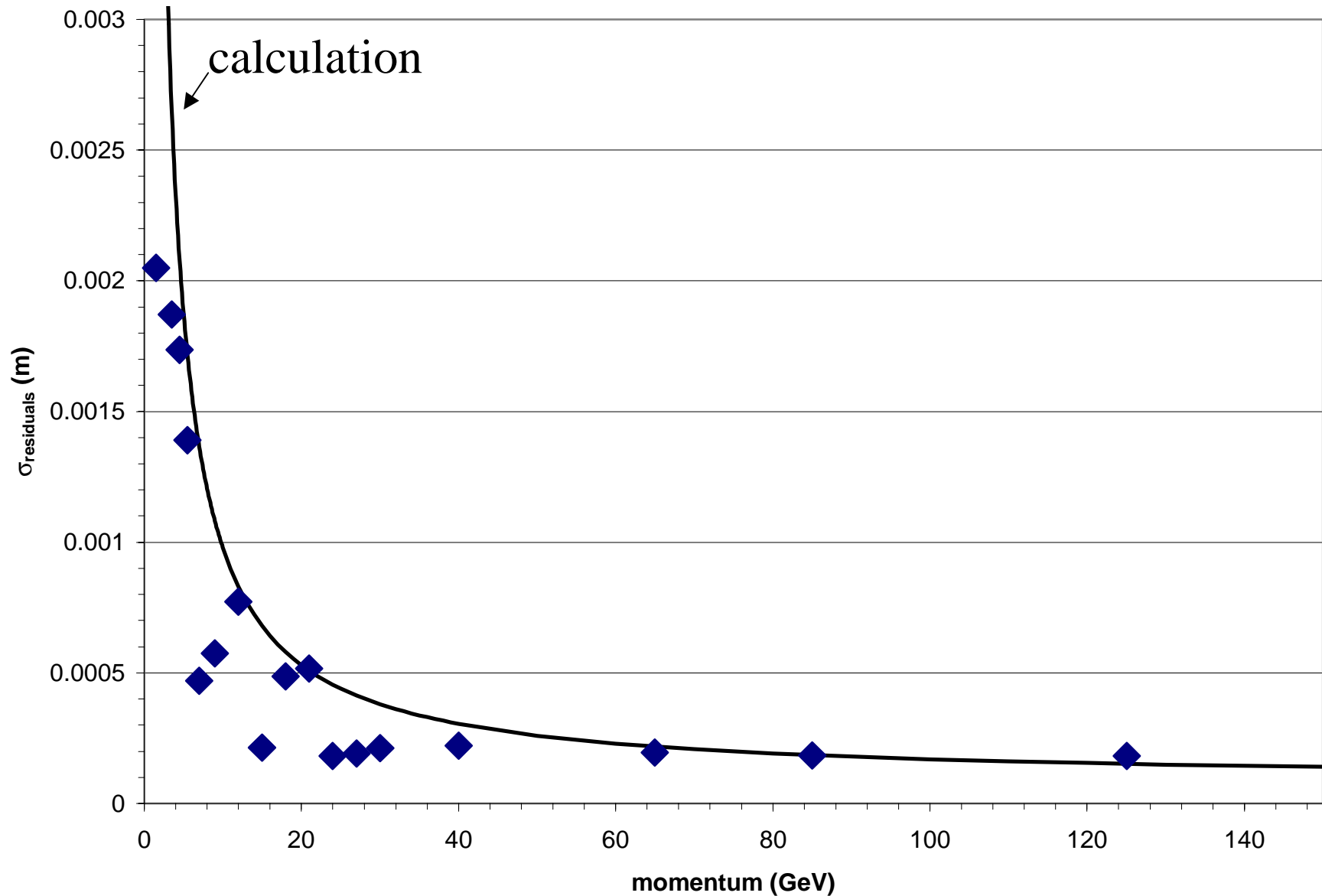
Method of local maxima

- a fiber hit is used if it has the largest pulseheight in its vicinity
 - every other fiber within a distance of 1 fiber unit must have a smaller pulseheight
 - or if its pulseheight is >2000 ($>\text{muon peak}$)
- Used with the new SF decoder to improve track predictions
- better than fiber clustering

Results

- Plot of muon momentum versus the average distance of all hits to the track projection.
 - Histogram the distance between track and hit used in the track for each track
 - find the rms of this distance for all tracks within a certain momentum range.

Muon momentum versus hit distance to the track projection



Sample calculation

Scattering angle:

$$\theta_0 = \frac{13.6 \text{ MeV}}{\beta c p} z \sqrt{\frac{x}{X_0}} \left[1 + 0.038 \ln \left(\frac{x}{X_0} \right) \right]$$

With: $z = 1$ (charge number)

$$\frac{x}{X_0} \approx 12 \text{ (distance in radiation lengths)}$$

$$\beta c p = 10 \text{ (velocity * momentum)}$$

Then $s_{plane}^{rms} = \frac{1}{4\sqrt{3}} x_{tot} \theta$, the rms distance between the trajectory and the straight line fit, projected onto a plane.

x_{tot} is the total distance

Sample calculation (2)

Theory: for muons with $p=10\text{GeV}$

$$s_{plane}^{rms} = 0.0009m$$

Data:

$$\sigma_{\text{residuals}} \approx 0.0008m$$

They agree!

- But:
- I just picked a point where they agree.
 - The momentum measurement has large uncertainties.
 - The determination of the residuals has large uncertainties (\rightarrow statistics).

Conclusion and Outlook

- The average distance between a track hit and the straight line fit depends on the momentum below 20GeV.
- The dependence is well described by the known multiple scattering formula.
- No further studies are planned.